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Historical paper

"The world is upside down" – The Innsbruck Goggle Experiments of Theodor Erismann (1883–1961) and Ivo Kohler (1915–1985)

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ABSTRACT

The "Innsbruck Goggle Experiments" on long-term wearing of reversing mirrors, prismatic and half prismatic goggles, and colored half goggles represent a milestone in research on *adaptation* (adapting to the introduced "disturbance") and *after-effects* (after removal of the "disturbance"). By means of these goggles it is, for example, possible to invert or distort the visual field (such as flipping top and bottom or left and right), as well as to observe how individuals learn to change the image back to vertical or recognize left and right. The Innsbruck Experiments gave decisive momentum to further international research on the ontogenetic development of perception, special perception, color perception, perceptual constancy, sensorimotor coordination, as well as to the development of theories. In the current paper, aside from presenting the history and results of selected studies, we will give an introduction to the life and work of the protagonists of these studies in Innsbruck, namely Theodor Erismann (1883–1961) and Ivo Kohler (1915–1985). Furthermore, we will propose ideas for future research on cognition and neuroscience.

1. Introduction

The famous "Innsbruck Goggle Experiments" were set off by a question that had been posed by the philosopher Oscar Kraus (1872–1942) from Prague: Does whatever you see by nature have to be "in front" of you? "By means of mirrors, it is easy to invert front and back, and then to observe whether in a longer-lasting experiment objects that are actually behind you will tenaciously be seen 'in front' of you – or whether your perception will adjust" (Kohler, 1953a, p. 181).[1] Theodor Erismann and his colleague Hubert Rohracher (1903–1972)

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[1] All original German literally cited textpassages, were translated by the authors, unless specified otherwise.

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studied this question by means of a retroscope (a mirror system for reversing images), which inverts "front" and "back". They presented their first results in 1931, under the title "'Seeing with the back of your head' and orientation in a world seen from that perspective" (Rohracher, 1932a). Studies on seeing "upside down" with reversing spectacles, however, received more attention in public, as did studies involving prism spectacles and colored spectacles and their effects, such as apparent movements, color distortions, and after-effects when the spectacles had been removed. Two protagonists, namely Theodor Erismann and Ivo Kohler, are rightly seen as pioneers and designers of the Innsbruck Goggle Experiments; their experiments in the field of psychology of perception received wide recognition.

The first researcher, however, who brought forth the idea to investigate the adaptation of the perception system after retinal images had been artificially and systematically changed (i.e., by "disturbing" the perception), was George M. Stratton (1865–1957) from the University of California at Berkeley (1896, 1897a, 1897b, 1899; see also Stern, 1898; Carr, 1935). He composed optical lenses in a short pipe in such a way that they would put the retinal image upright when placed in front of the eyes. Thus, the first ever reversing spectacles had been created. Stratton's result of experimenting with these spectacles was twofold: It concerned *external behavior* (failure of grabbing objects, walking, evading, etc.) and *vision* (tables, chairs, the own feet would "hang in the air", feet would walk on the "ceiling", taps would drip "upwards", candle flames would point "downwards", etc.). In the end of the experiment, there were – despite of the reversing spectacles – moments of upright vision; and after removing the spectacles, there was again the impression of everything "being topsy-turvy". After 87 h of using reversing spectacles, Stratton proposed that an upside-down retinal image is not necessary for upright vision. The brain would create a coherence in the reversed image between what a person is seeing, hearing, and feeling. The adjustment of seeing, in his opinion, remained just an illusion (see also Ewert, 1936; Stagner & Karwoski, 1952). Although his self-experiments lasted seven days (he wore eye patches at night), these studies were incomplete. The reversing spectacles only allowed for a small visual field and monocular vision. Furthermore, the reversed image also inverted right and left, making the experiment even more difficult. Nevertheless, Stratton's study can be seen as a starting point for a series of important studies. In these, a variety of image modifications (stimulus transformations) were implemented by selecting and constructing suitable optical systems, and their effects on human and animal perception were investigated. The early studies by Brown (1928), Ewert (1930, 1936, 1937), Gibson (1933, 1937), Peterson and Peterson (1938), Krüger (1939), and Foley (1940), which emerged independently from the Innsbruck group, are worth mentioning. In sum – even if a minority of the findings are contradictory – these results point to the following conclusion: If two different sensory signals are conflicting constantly for a longer period of time, the brain will adapt to this conflict.

In the following section, we will introduce the strained biographies of the Innsbruck Goggle Experimenters, Erismann (Fig. 1), and Kohler (Fig. 2).

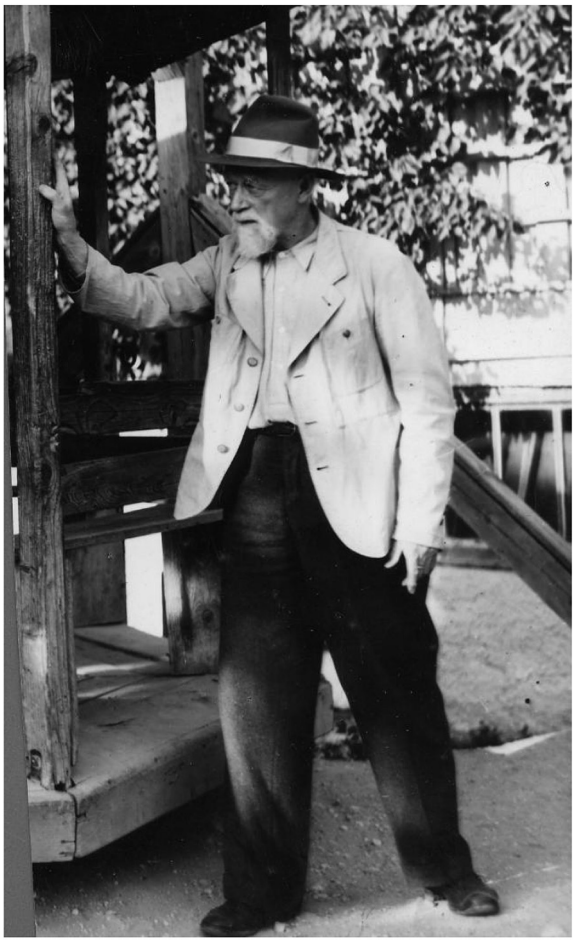

Fig. 1 – Theodor Erismann.

2. Biography

2.1. *Theodor Erismann (1883–1961)*

Erismann was born on September 16, 1883, in Moscow. His Swiss father, Friedrich Erismann (1842–1915), worked in Russia for a quarter-century as an ophtamologist, hygienist, and community physician. In 1881, he received an honorary doctoral degree of the University of Moscow, in 1884, he became an Ordinarius for Hygiene. From 1891 he was the director of the Department of Hygiene, and in 1894 he was president of the society of Russian medical doctors. In Zurich, he was university professor and chairman of the municipal health service (see also Rogger & Bankowski, 2010). Theodor Erismann's Russian mother Sophia Jakowlewna Erismann, born Hasse (1847–1925), was one of the first women in Switzerland to take a doctoral degree in Medicine (University of Bern, July 4, 1876). Because of his connections to and support of liberal, anti-czarist, and revolutionary students, Friedrich Erismann lost his position at the University of Moscow, thus being forced to leave Russia in 1896 and to emigrate to Switzerland. Subsequently (1896–1902), Theodor Erismann attended secondary school (*Realgymnasium*) in Zurich and enrolled at the University of Zurich in 1902. He studied with experimental physicist Alfred Kleiner (1849–1916) and the